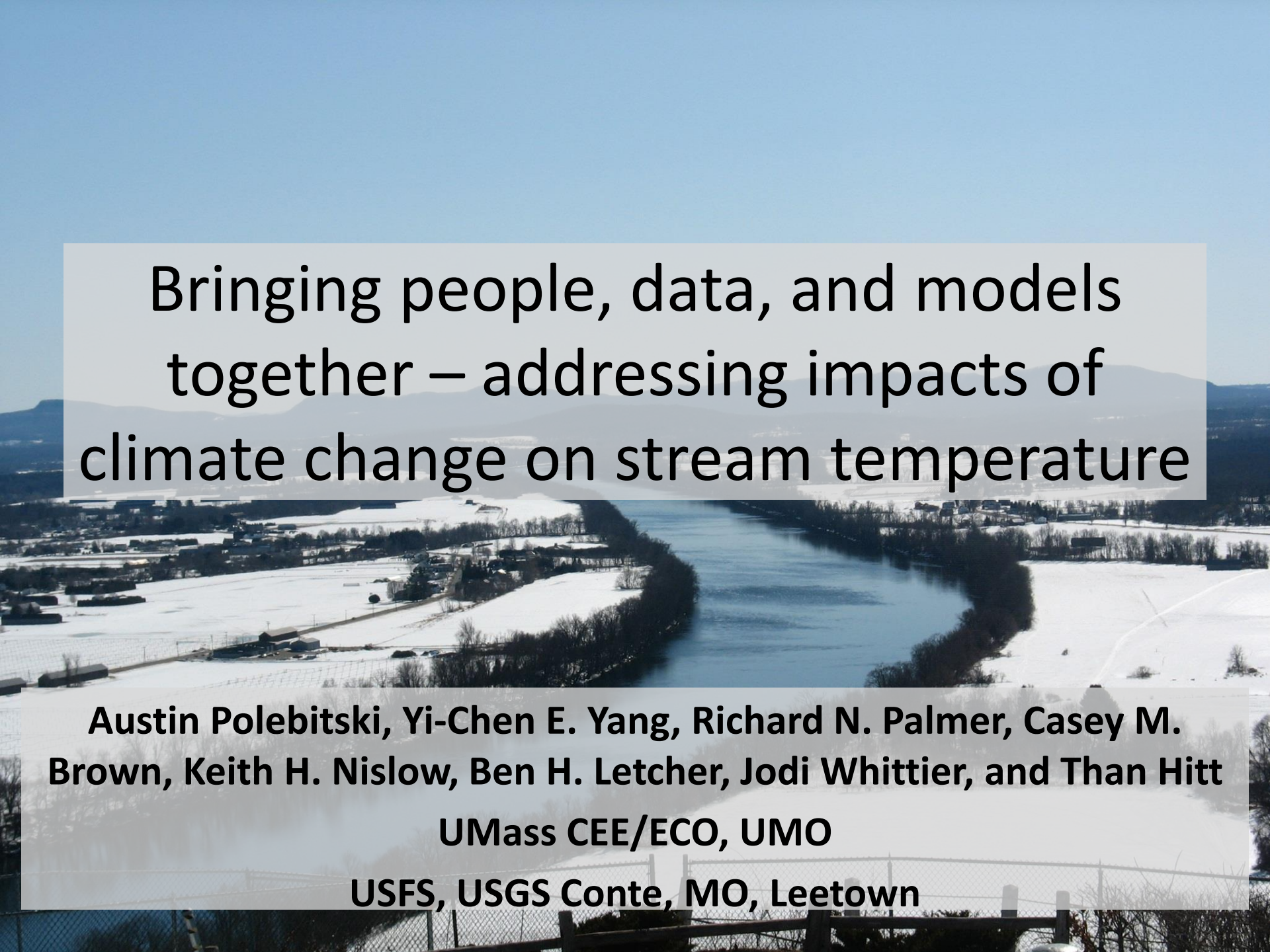

Bringing people, data, and models together – addressing impacts of climate change on stream temperature

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Project Objectives

What data and modeling frameworks are needed to provide scientists reliable, climate-informed, water temperature estimates for freshwater ecosystems that can assist watershed management decision making?

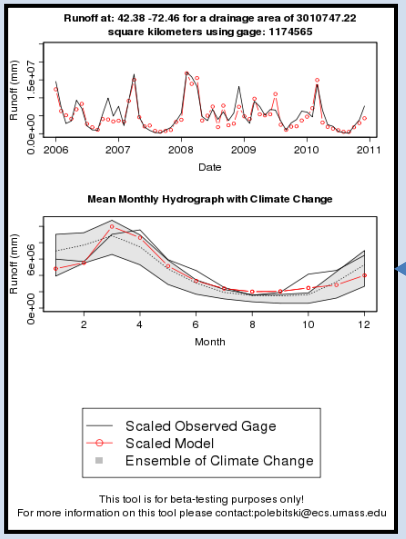
Project Need

- Stream Temperature Workshop (Letcher and Abele)
  - Post workshop survey found that 90% of respondents would benefit from centralized storage of stream temperature data, many wanting both location and data stored
  - 95% of the agencies surveyed agreed that a spatially nested year round network would be beneficial to current monitoring efforts
  - Respondents wanted stream temperature models capable of gaged and ungaged temperature prediction

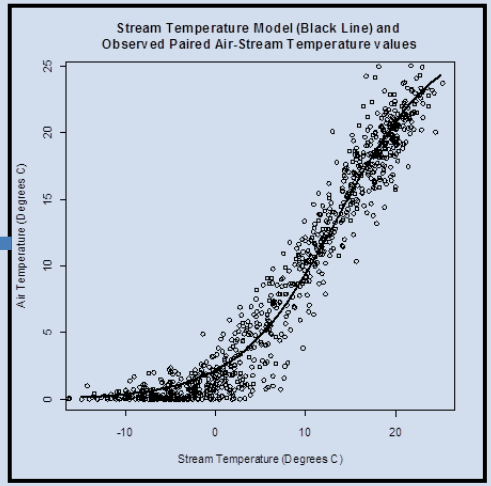
Community Driven Data Gathering and Collection

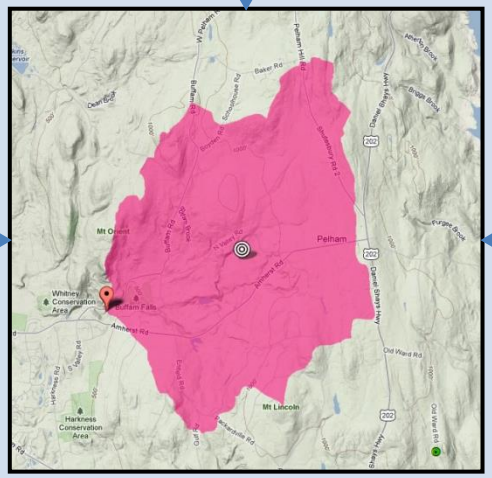
Online Portal/Database for Housing and Querying Data

User Generated Results



User Developed Models





Web-based Applications Linking Models to Data

Project Tasks

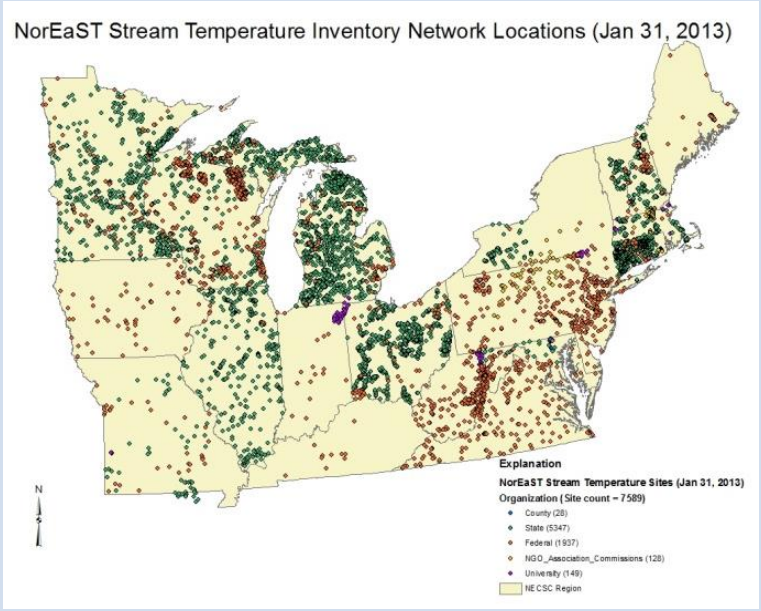
- ***Task 1 – Gather, analyze, and deploy temperature data and loggers***
- ***Task 2 – Stream temperature model intercomparison***
- ***Task 3 - Build foundational/pilot data repository and modeling framework website***

Task 1 – Gather, analyze, and deploy temperature data and loggers

- *Use existing connections to gather regional data*
- *Deploy loggers to cover gaps and to gather long-term fine-grained data in 9-10 watersheds*
- *Quality Assurance/Quality Control*

Task 1 – Gather, analyze, and deploy temperature data and loggers

- More than 7500 locations
  - For New England gathered over 4 Gbs of stream temp data
- *Using network coverage to inform deployment of loggers (Spring 2013)*
- *Developing Quality Assurance/Quality Control Plan*
  - *All respondents to survey agreed a simple and easily implementable QAQC and deployment protocol is needed*



Task 2 – Gather, analyze, and deploy temperature data and loggers

- *Literature Review- Document and evaluate existing models for coarse and fine-grained ability*
- *Evaluate stream temperature models using coarse and fine grained data for selected watersheds and regional estimates*

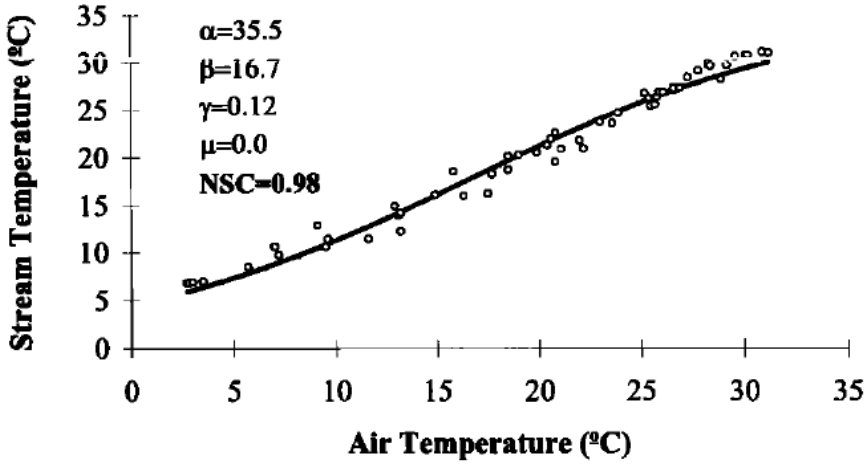
Literature Review

Reference	Model	Model Heat Fluxes	Time Step	Model Type
Allen et al. (2007)	BasinTEMP	Surface, groundwater	Daily	Physically-based
Arnold et al. (1998)	SWAT	NA	Daily	Empirical
Bicknell et al. (1997)	HSPF	Surface, groundwater, bed conduction	Hourly	Physically-based
Chapra et al. (2006)	QUAL2K	Surface, groundwater, bed conduction	Less than Hourly	Physically-based
Issak et al. (2009)	MRSTM	Stream network, geomorphology, climate, landscape features, fire effects	Daily	Empirical
Theurer et al. (1984)	SNTEMP	Surface, groundwater, bed conduction, friction	Daily	Physically-based
Peterson and Ver Hoef (2010)	Spatial Model	Stream network, geomorphology, climate, landscape features, fire effects	Daily	Empirical
Mohseni et al. (1999)	Nonlinear Regression	NA	Weekly	Empirical
Poff et al. (1996)	ANN	NA	Daily	Empirical
Tung et al. (2007)	Physical model	Surface, groundwater, bed conduction, vegetation effect	Hourly	Physically-based

Nonlinear Stream Temperature Model

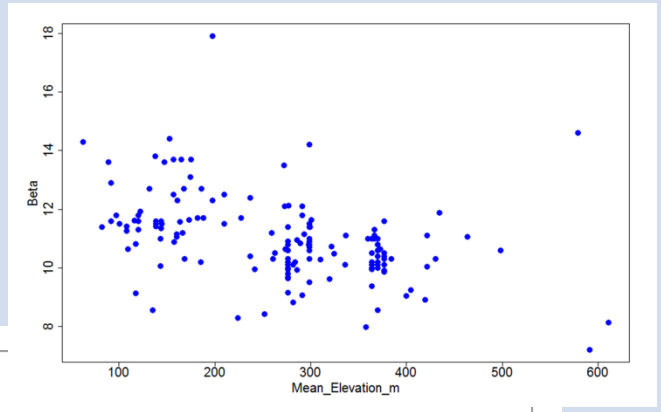
- Nonlinear Regression developed by Mohseni et al. 1998
- Function fit using maximum and minimum stream temperature and air temperature
- Works very well on weekly time step
- Fit using Bayesian framework may improve scalability to areas lacking data

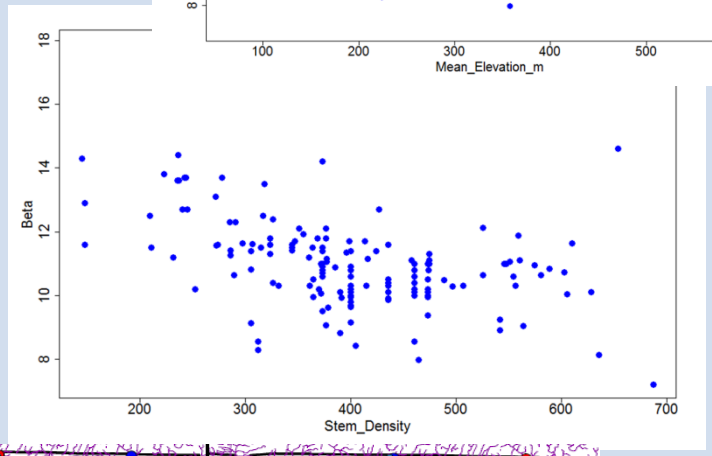
$$T_s = \mu + \frac{\alpha - \mu}{1 + e^{\gamma(\beta - T_a)}}$$

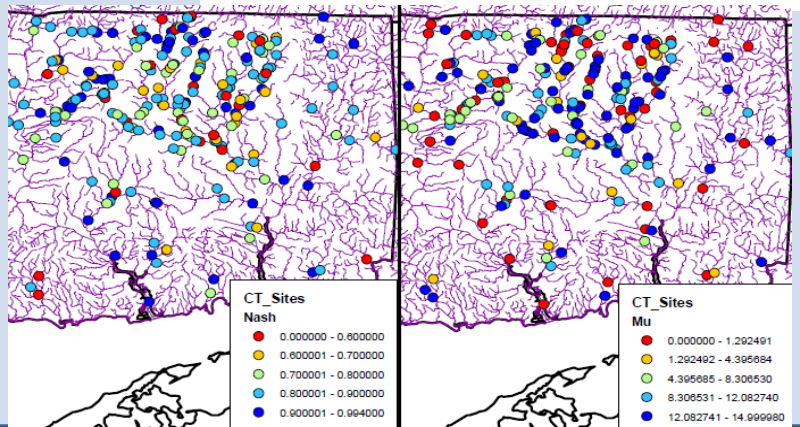


Regionalizing Parameters

- Currently examining:
  - Baseflow Index
  - Elevation
  - Riparian Cover
  - Land Use
  - Soil Properties
- Explore how regional parameters perform against regionalized parameters
- Sensitivity analysis

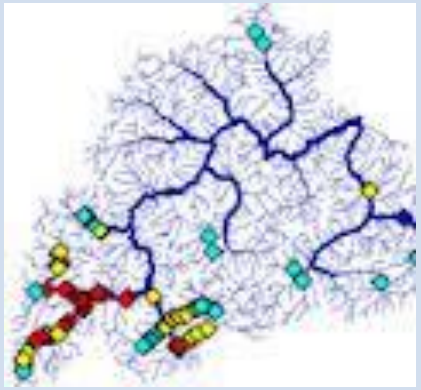






Other Stream Temperature Models

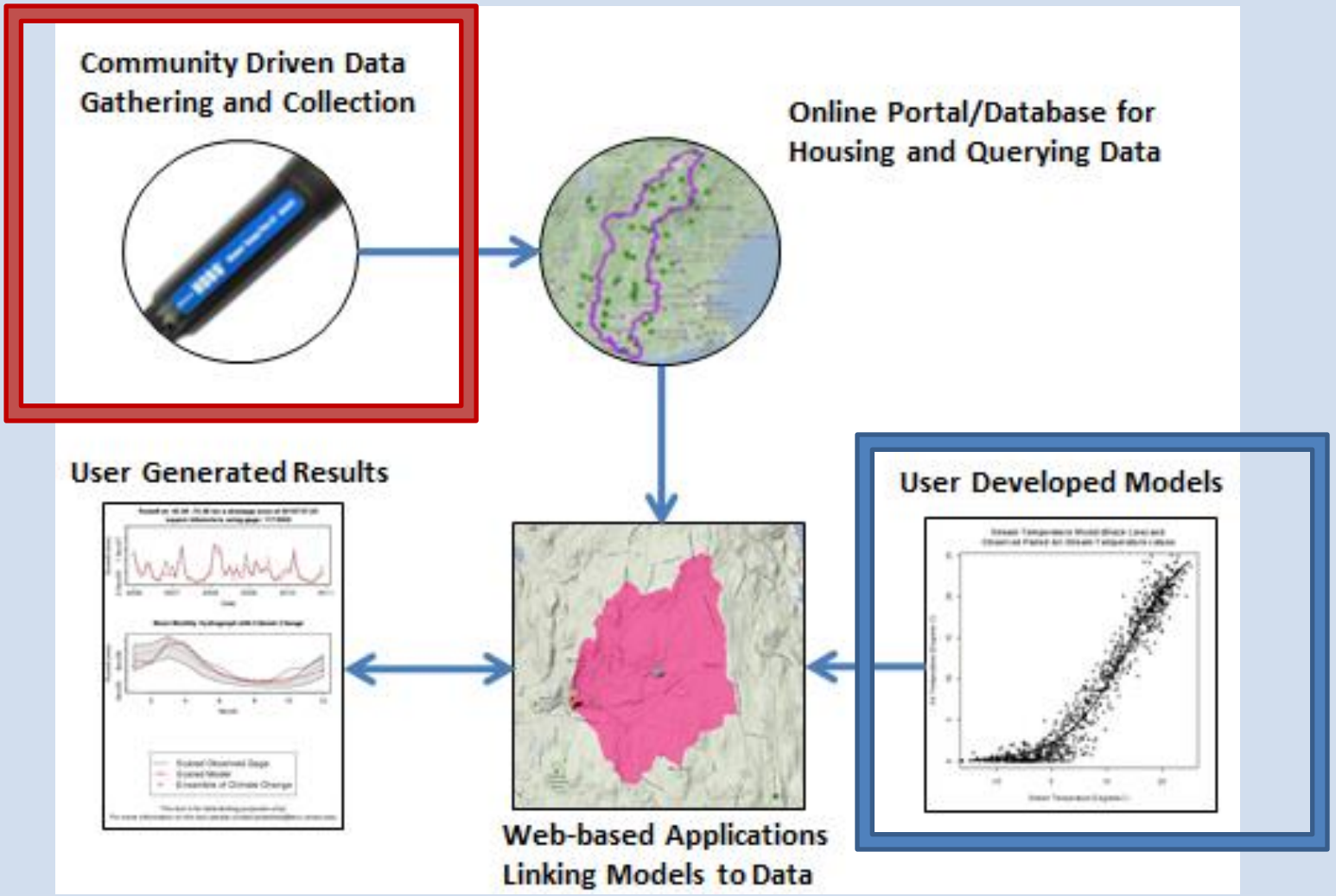
- Spatial Stream Temperature
  - Developing Peterson and Ver Hoef spatial models for 5 different locations for comparative purposes
  - Examining important variables across NECSC
- Physically Based
  - Coupled stream temp hydrology model (VIC)



Task 3 – Build foundational/pilot data repository and modeling framework website

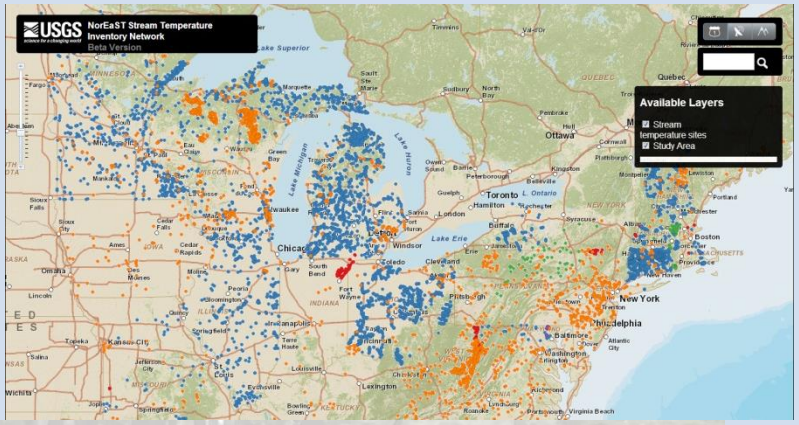
- *Web Clearinghouse for Community Driven Data Collection and Retrieval*
- *Framework for User Developed Stream Temperature Models*

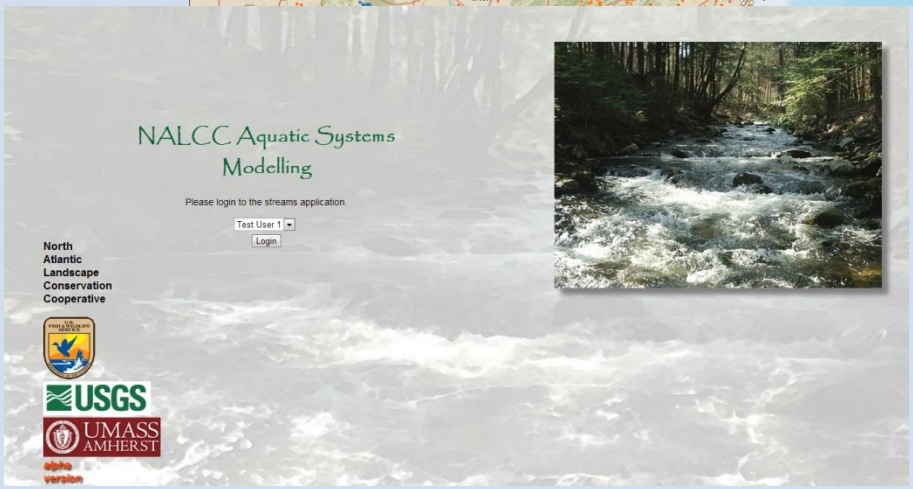
Where are we headed with Stream Temperature?



Task 3 – Build foundational/pilot data repository and modeling framework website

- Examining adding functionality to NorEAST website
  - Future Proposal
- Letcher NALCC modeling web portal





Sum It Up! Opportunities, Needs, and Audiences

- **Opportunities**
  - **More data!**
  - Others joining model intercomparison
  - Those wanting to develop coherent stream temperature monitoring framework
  - Using output from groups such as McGarigal Lab, etc…
- **Needs**
  - More data! Specifically for spatial models
  - Model application -> fish models, benthic, TMDL?
- **Audiences**
  - Anyone collecting stream temperature data
  - Anyone requiring stream temperature data or modeling for decision making

Thank you!